Armor Considerations for Ground Platforms

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

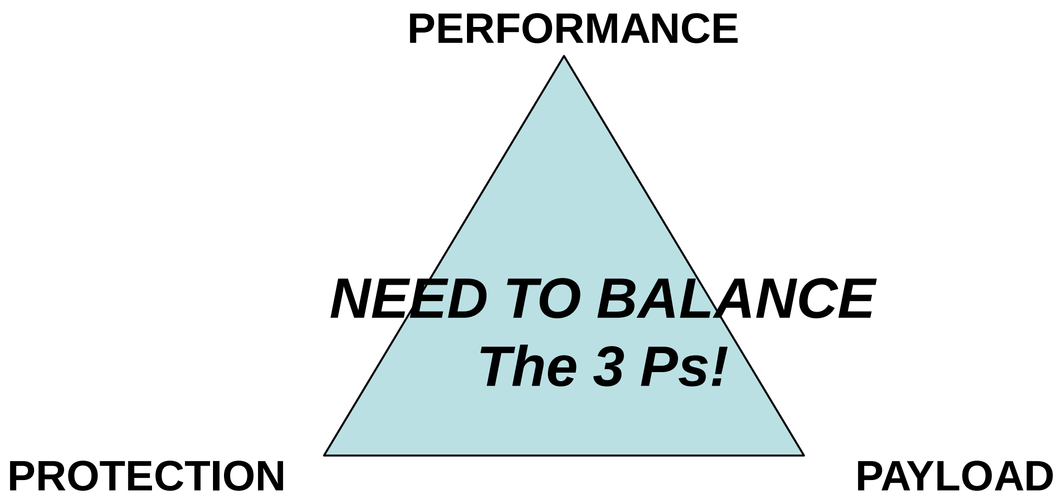
Goal:

To develop advanced armor technologies that provide ground combat and tactical wheeled vehicles capability to provide enhanced protection (multiple threats), weight reduction, and adaptability to threat evolution

Motivation

DRIVERS

- **Lightweight / Mobile**
- **Threat Designable / Repairability**
- **Armor: Multifunctional Ballistic / Structural**



Armor Design

- **Optimal use of mechanics and materials**
  - Understand/use mechanics to obtain desired effect
  - Use materials that will amplify the performance of the mechanics
  - Demand “ultimate” performance from materials

Numerical simulations are an integral portion, providing understanding and direction

Vehicle Armor Damage Concerns

• Fabrication issues ("Was that supposed to go in there?")

• Logistical issues ("Did you drop that?")

• Non-combat impact ("Where did that [tree, ditch, wall, (fill in your own)] come from?")

• Combat impacts (penetrating AND non-penetrating ballistic events, blast)

Materials for Ground Platforms

–Ideal situation: materials readily available and fully developed.

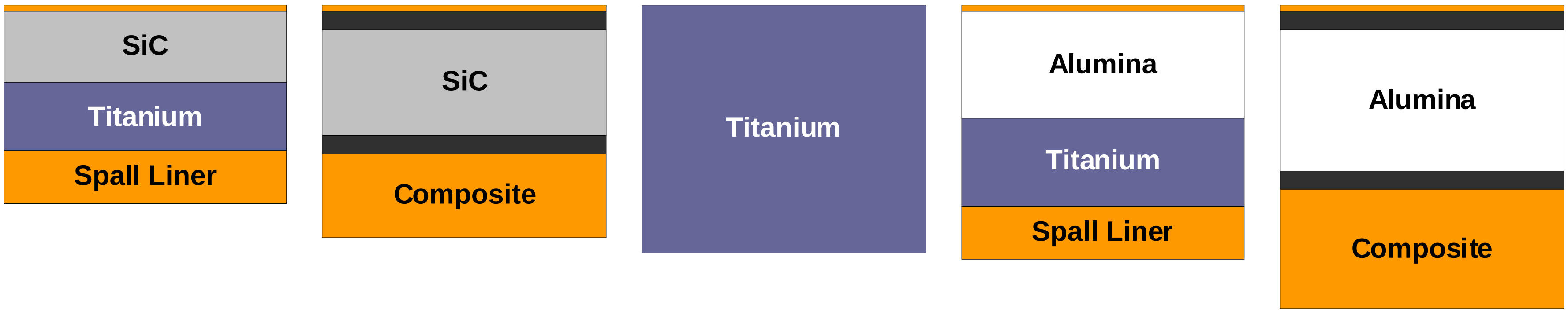
- RHA
- High hard steel
- Aluminum

–Reality: Research projects are ongoing to further develop advanced lightweight armors.

- Composites
- Ceramics
- Titanium
- Magnesium
- Composite and metal matrix
- ????????

Design Drivers – Cost / Weight / Volume

- **Silicon Carbide Armor Tile Comparison at Equivalent Ballistic Protection**



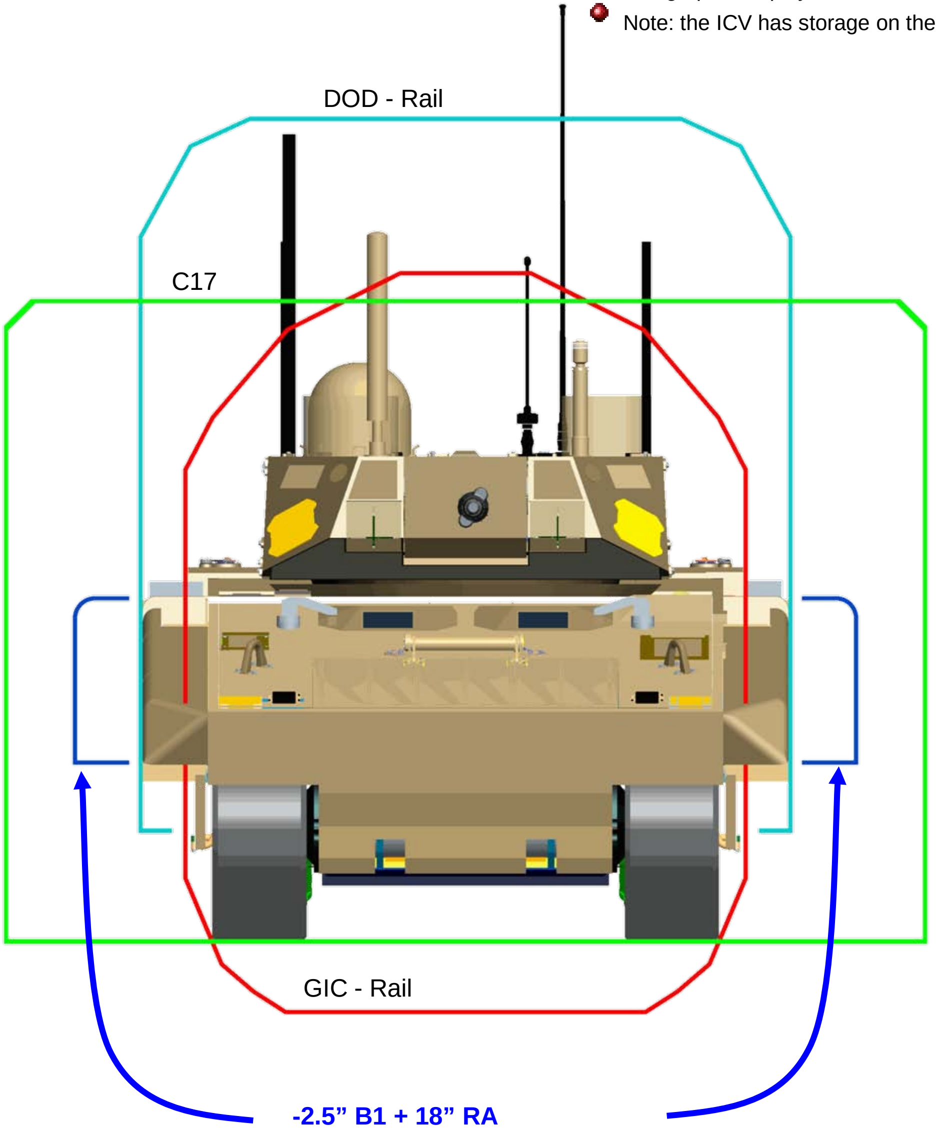
20-23 psf	20 psf	40 psf	30-33 psf	30 psf
$80/lb*	$80/lb*	$30/lb*	$50/lb*	$35/lb*
1.0-1.5”	1.65”	1.75”	1.5-2.0”	2.15”

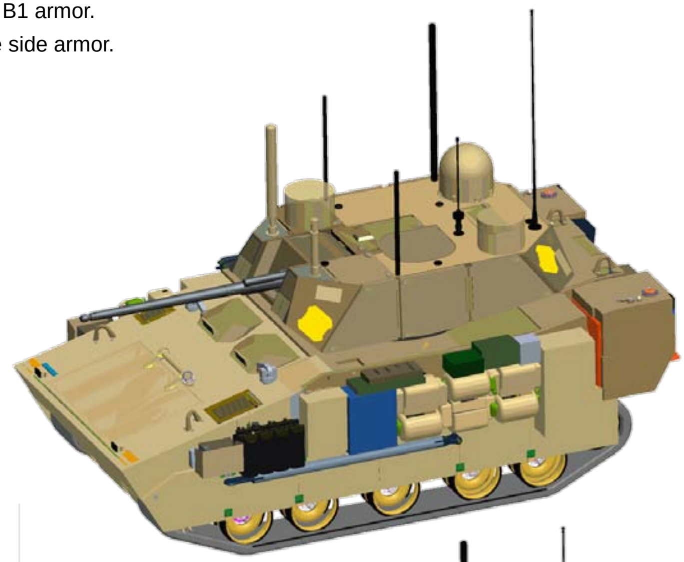
- (production cost)
- **Titanium & Aluminum / Lithium Alloy Raw Material Cost**

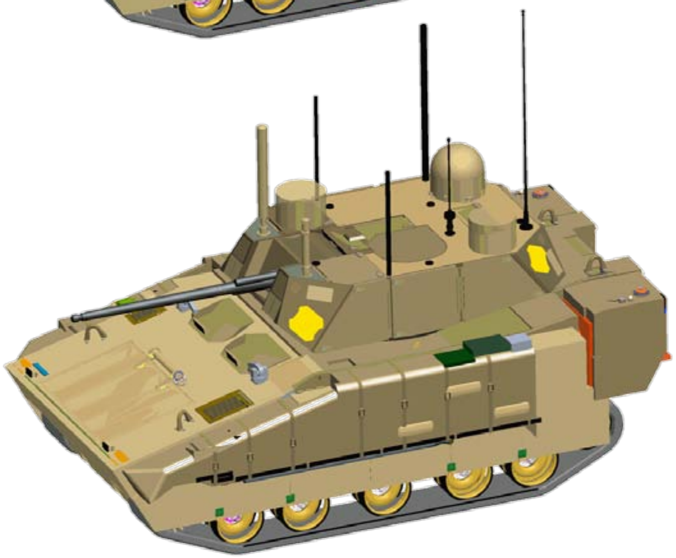
  ~$12 / lb vs. ~$4 / lb for Conventional Aluminum

Transportability Assessment

- The graphic displays RA outline minus the 2.5” B1 armor.
- Note: the ICV has storage on the outside of the side armor.







Combat Vehicles

Current

- Thick, heavy armor
- Structure as by-product of armor
- Inherently damage tolerant
- Arrive on ships
- Well understood materials and manufacturing practices
- Designed for force-on-force engagement
- Cumbersome logistics tail
- Basic situational awareness

Future

- Lightweight armor
- Structure plus armor (A + B)
- Relatively damage intolerant
- Air transportable (C-130)
- Advanced ceramic armors, use of polymer composites and associated mfg. practices
- Designed for noncontiguous, non-linear, reorganizing battlefield
- Common components, reduction of logistics footprint
- Network centric, highly interdependent

Tactical Vehicles

Current

- Tired and aging fleet
- Corrosion prone
- Cabs typically unarmored. Armoring via add-on-armor kits
- Reduced vehicle payload, maneuverability, reliability, safety, maintainability, and life expectancy
  - Increased wear and tear on vehicle components, fuel consumption, and life cycle costs
- Multiple original equipment manufacturers, little commonality
  - Designed for traditional role of logistics support

Future

- Recapitalization with appliqué armor (A-kit/B-kit)
- Be more survivable in mine blast events
- Component commonality (hardware, transparent armor, B-kit panels
- Gun turret and advanced countermeasures
- Crew installable B-kit, with minimal tools
- Enhanced crew survivability to meet threat
- Increased system reliability
- Taking on more of an assault role




SUMMARY

- Significant challenges remain in areas of material development and mechanisms

- Modeling and simulation is a critical enabler